CLAIMS

1. Gas separation device for a physiological fluid, comprising:

- a containing body having an internal active surface and having at least a first inlet aperture for a physiological fluid, positioned with a tangential direction of access, and at least one outlet aperture for the said fluid, spaced apart from the said inlet aperture; characterized in that it comprises:

- a guide element housed at least partially within the said body and having a continuous active surface designed to contact and guide the said fluid;

- a first annular chamber formed between the active surface of the said guide element and the internal active surface of the said containing body.

2. Device according to claim 1, characterized in that the said inlet aperture opens directly into the said first chamber.

3. Device according to claim 1, characterized in that the said guide element is wholly housed within the containing body, extends coaxially with the latter and is spaced axially apart from the said outlet aperture.

4. Device according to claim 3, characterized in that the active surfaces of the said containing body and of the said guide element face each other and are shaped in the form of surfaces of revolution about a common axis of symmetry which is transverse with respect to the tangential direction of access of the said flow.

5. Device according to claim 1, characterized in that the said outlet aperture is positioned in a lower end of the said containing body, the said guide element and

the said first chamber extending above the said outlet aperture.

6. Device according to claim 1, characterized in that the said guide element is a solid or internally hollow solid of rotation, designed to reduce the volume of at least the said first chamber.

7. Device according to claim 1, characterized in that the said guide element comprises:

- a central portion;
- a first terminal portion, facing towards the said outlet aperture; and
- a second terminal portion, axially opposed to the first terminal portion and facing towards a second chamber extending above the said guide element.

8. Device according to claim 7, characterized in that the first terminal portion has a cross section whose radial dimension is reduced progressively towards the said outlet aperture.

9. Device according to Claim 8, characterized in that the said first terminal portion has a conical shape with its vertex facing towards the outlet aperture.

10. Device according to Claim 7, characterized in that the second terminal portion has a cross section whose radial dimension is reduced progressively away from the said outlet aperture.

11. Device according to Claim 10, characterized in that the said second terminal portion has a conical shape with its vertex opposed to the outlet aperture.

12. Device according to Claim 7, characterized in that the central portion has a cross section with a radial dimension which is reduced progressively away from the

said terminal portions, to form an intermediate area having a minimum radial dimension.

13. Device according to Claim 12, characterized in that the central portion has a curved profile in longitudinal section.

14. Device according to Claim 7, characterized in that the said active surface of the containing body has:

- a first area, of maximum radial dimension, extending around the central portion of the guide element;
- a second area, whose radial dimension is reduced progressively towards the outlet aperture, the second area extending consecutively to the first area and essentially around the first terminal portion of the guide element;
- a third area, whose radial dimension is reduced progressively away from the outlet aperture, the third area extending consecutively to the first area and essentially around the second terminal portion of the guide element.

15. Device according to Claim 14, characterized in that the first inlet aperture opens into the said first chamber, in the said intermediate first area of the active surface of the containing body.

16. Device according to Claim 14, characterized in that the first area of the active surface has a constant radius.

17. Device according to Claim 1, characterized in that the said containing body comprises a second inlet aperture located above the said first inlet aperture and designed to convey a second fluid into the containing body.

18. Device according to Claim 17, characterized in that it comprises a second chamber extending above the said

guide element, in an axially consecutive position and in fluid communication with the said first chamber and with the said second inlet aperture.

19. Device according to Claim 18, characterized in that the said second inlet aperture opens directly into the said second chamber, preferably in a direction parallel to, and staggered with respect to, that of the said first inlet aperture.

20. Device according to Claim 18, characterized in that the said containing body includes a third chamber, which is axially consecutive to the said second chamber and which is designed to contain the gas separated from the said fluids, the said third chamber extending in the top of the said containing body.

21. Device according to Claim 20, characterized in that it comprises at least one service line having a first end which is brought into fluid communication with the said third chamber by means of a fourth aperture formed in the said containing body.

22. Device according to Claim 21, characterized in that it comprises at least one pressure sensor element associated for operation with the said service line.

23. Device according to Claim 21, characterized in that it comprises at least one hydrophobic membrane associated for operation with an intermediate area of the service line.

24. Device according to Claim 21, characterized in that the third chamber has a nominal volume V_c delimited below by a theoretical maximum level line BL and above by the said fourth aperture.

25. Device according to Claim 21, comprising a pneumatic circuit operating in the said service line, for

selectively sending gas to the service line and drawing gas from it.

26. Device according to Claim 25, comprising a liquid level sensor LLS located above a level BL, and a control unit connected to the sensor LLS and designed to control the said pneumatic circuit to maintain the liquid level in the vicinity of the said level BL.

27. Device according to Claim 26, in which the level sensor LLS operates in a section of the service line and in which the said control unit is designed to cause the execution of the following steps:

- determining whether LLS is signalling the presence of liquid, and, if so, executing the following sub-steps in sequence:

  a) activation of the pneumatic circuit to drive towards the third chamber a volume V_1, equal to the volume between the section in which LLS operates and the fourth aperture,

  b) activation of the pneumatic circuit to draw gas from the third chamber while LLS continues to signal the presence of liquid,

  c) activation of the pneumatic circuit to drive towards the third chamber a volume of liquid V_2, equal to $V_1 + V_c$, where V_c is the volume of the third chamber;

- if, on the other hand, LLS is not signalling the presence of liquid, executing the aforementioned three steps a), b) and c) at specified time intervals.

28. Device according to Claim 21, characterized in that it comprises at least one access site located in the said service line for manually drawing fluid from the said line or sending fluid into it.

29. Device according to Claim 26, characterized in that the level sensor LLS can operate on the said containing body.

30. Device according to Claim 1, characterized in that it comprises:

- a first line for sending the physiological fluid into the said containing body through the first inlet aperture,
- a second line for sending a second fluid into the said containing body through a second inlet aperture,
- a pump operating to create a flow along the first line,
- a pump operating to create a flow along the second line,
- a control unit programmed to control the pumps operating in the first and second lines and to ensure the constant presence in the containing body of a layer of the said second fluid whose thickness lies within a specified range, this layer being located above the physiological fluid.

31. Fluid mixing device with gas separation, comprising a containing body having an internal active surface and having at least one first inlet aperture for a physiological fluid, and at least one fluid outlet aperture, spaced apart from the said first inlet aperture, characterized in that the containing body has at least one second inlet aperture located above the said first inlet aperture and designed to convey a second fluid into the containing body to form a layer of the said second fluid above the said physiological fluid.

32. Device according to Claim 31, characterized in that the said containing body includes:

- at least a first chamber extending in a lower area of the containing body and in fluid communication with the said outlet aperture;

- at least a second chamber, extending in an axially consecutive upper area and in fluid communication with the said first chamber.

33. Device according to Claim 32, characterized in that the said containing body includes a third chamber, which is axially consecutive to the said second chamber and which is designed to contain the gas separated from the said fluids, the said third chamber extending in the top of the said containing body and having a fourth aperture.

34. Device according to Claim 33, characterized in that it comprises at least one service line having a first end which is brought into fluid communication with the said third chamber by means of the fourth aperture formed in the said containing body.

35. Device according to Claim 34, characterized in that it comprises at least one pressure sensor element associated for operation with the said service line.

36. Device according to Claim 35, characterized in that it comprises at least one hydrophobic membrane associated for operation with an intermediate area of the service line, between the fourth aperture and the pressure sensor element.

37. Device according to Claim 33, characterized in that the third chamber has a nominal volume V_c delimited below by a theoretical maximum level line BL and above by the said fourth aperture.

38. Device according to Claim 34, comprising a pneumatic circuit for selectively sending gas to the service line and drawing gas from the line.

39. Device according to Claim 38, comprising a liquid level sensor LLS located above a level BL, and a control unit connected to the sensor LLS and designed to control the said pneumatic circuit to maintain the liquid level in the vicinity of the said level BL.

40. Device according to Claim 39, in which the said level sensor is located in the said service line and the said control unit is designed to cause the execution of the following steps:

- determining whether LLS is signalling the presence of liquid, and, if so, executing the following sub-steps in sequence:

  a) activation of the pneumatic circuit to drive towards the third chamber a volume V_1, equal to the volume between the section in which LSS operates and the fourth aperture,

  b) activation of the pneumatic circuit to draw gas from the third chamber while LSS continues to signal the presence of liquid,

  c) activation of the pneumatic circuit to drive towards the third chamber a volume of liquid V_2, equal to $V_1 + V_c$, where V_c is the volume of the third chamber;

- if, on the other hand, LLS is not signalling the presence of liquid, executing the aforementioned three steps a), b) and c) at specified time intervals.

41. Device according to Claim 34, characterized in that it comprises at least one access site located in the said service line for manually drawing fluid from the line or sending fluid to it.

42. Device according to Claim 39, characterized in that the level sensor LLS operates on the said containing body.

43. Device according to Claim 31, characterized in that it comprises:

- a first line for sending the physiological fluid into the said containing body through the first inlet aperture,
- a second line for sending the second fluid into the said containing body through the second inlet aperture,
- a pump operating to create a flow along the first line,
- a pump operating to create a flow along the second line,
- a programmable control unit for controlling the pumps operating in the first and second lines and for ensuring the constant presence in the containing body of a layer whose thickness lies within a specified range, this layer being located above the physiological fluid.

44. Device according to Claim 43, characterized in that the control unit activates the pump operating in the said second line in a continuous or intermittent mode, to provide a specified flow rate at every specified time interval.

45. Device according to Claim 43, characterized in that it comprises a means for sensing the actual flow in the second line, this sensor means sending corresponding signals to the said control unit.

46. Device according to Claim 43, in which the thickness of the said layer is smaller than the maximum diameter of the internal surface of the containing body.

47. Device according to Claim 32, in which the said first inlet aperture opens directly into the said first chamber in a tangential direction of access, and in which the said second inlet aperture opens directly

towards the said second chamber in a direction of access parallel to that of the said first aperture.

48. Device according to Claim 47, comprising a guide element housed at least partially within the said body and having a continuous active surface designed to contact and guide the said fluid, the said first chamber having an annular configuration and being formed between the active surface of the said element and the active surface of the containing body.

49. Device according to Claim 48, characterized in that the said guide element is wholly housed within the containing body, extends coaxially with the latter and is spaced axially apart from the said outlet aperture.

50. Device according to Claim 48, characterized in that the active surfaces of the said containing body and of the said guide element face each other and are shaped in the form of surfaces of revolution about a common axis of symmetry which is transverse with respect to the tangential direction of access of the said flow.

51. Device according to Claim 48, characterized in that the said outlet aperture is positioned in a lower end of the said containing body, the said guide element and the said first chamber extending above the said outlet aperture.

52. Device according to Claim 50, characterized in that the said guide element is a solid or internally hollow solid of rotation, designed to reduce the volume of at least the said first chamber.

53. Device according to Claim 48, characterized in that the said guide element comprises:

- a central portion;

- a first terminal portion, facing towards the said outlet aperture; and

- a second terminal portion, axially opposed to the first terminal portion and facing towards the said second chamber.

54. Device according to Claim 53, characterized in that the first terminal portion has a cross section whose radial dimension is reduced progressively towards the said outlet aperture.

55. Device according to Claim 54, characterized in that the said first terminal portion has a conical shape with its vertex facing towards the outlet aperture.

56. Device according to Claim 53, characterized in that the second terminal portion has a cross section whose radial dimension is reduced progressively away from the said outlet aperture.

57. Device according to Claim 56, characterized in that the said second terminal portion has a conical shape with its vertex opposed to the outlet aperture.

58. Device according to Claim 53, characterized in that the central portion has a cross section with a radial dimension which is reduced progressively away from the said terminal portions, to form an intermediate area having a minimum radial dimension.

59. Device according to Claim 58, characterized in that the central portion has a curved profile in longitudinal section.

60. Device according to Claim 53, characterized in that the said active surface of the containing body has:

- a first area, of maximum radial dimension, extending around the central portion of the guide element;

- a second area, whose radial dimension is reduced progressively towards the outlet aperture, the second area extending consecutively to the first area and essentially around the first terminal portion of the guide element;

- a third area, whose radial dimension is reduced progressively away from the outlet aperture, the third area extending consecutively to the first area and essentially around the second terminal portion of the guide element.

61. Device according to Claim 60, characterized in that the first inlet aperture opens into the said first chamber, in the said intermediate first area.

62. Device according to Claim 60, characterized in that the first area of the active surface has a constant radius.

63. Fluid mixing method with gas separation, comprising the following steps:

- providing a containing body having an internal active surface and having at least a first inlet aperture, at least one fluid outlet aperture spaced apart from the said first inlet aperture, and at least a second inlet aperture located above the said first inlet aperture;

- sending a first physiological fluid into the containing body through the said first aperture;

- conveying a second fluid into the containing body through the said second aperture to form a layer of the said second fluid above the said physiological fluid;

- conveying a separated gas from the said first and second fluids above the said layer.

64. Method according to Claim 63, characterized in that it comprises the steps of:

- measuring the flow rate of the said first fluid;
- measuring the flow rate of the said second fluid;
- regulating the flow rate of the said first and the said second fluid to provide a layer of the said second fluid with a thickness lying within a specified range.

65. Method according to Claim 64, characterized in that the said second fluid is sent, in continuous or intermittent mode, in a direction of access to the containing body parallel to that of the said first fluid.

66. Method according to Claim 64, characterized in that the thickness of the said layer is kept below the maximum diameter of the internal surface of the containing body.